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(54) **ELECTRICAL CONNECTOR WITH INTERNAL SHIELD**

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(51) **Int. Cl.**[7] **H01K 13/648**; H01K 24/00; H01R 33/46

(52) **U.S. Cl.** **439/607**; 439/676; 439/939

(58) **Field of Search** 439/607, 676, 439/626, 939, 609, 608, 610

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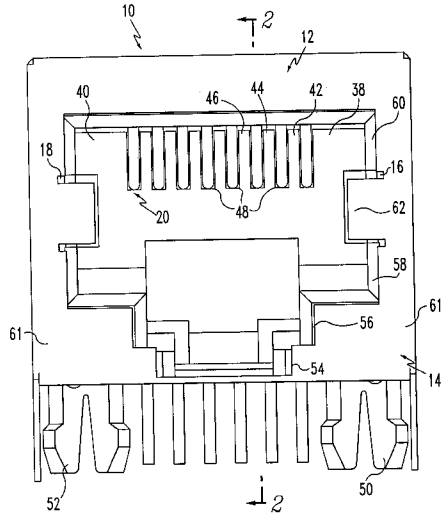
(57) **ABSTRACT**

An electrical connector has an insulating housing with an interior cavity for receiving a mating connector and a plurality of openings in communication with the interior cavity. A plurality of contacts, each of. which extends into the interior cavity of the housing from a respective one of the openings, electrically contacts conductors in the mating connector inserted into the interior cavity of the housing. An internal shield extends into the interior cavity from a respective one of the openings and is positioned between the plurality of contacts to create at least two groups of contacts.

39 Claims, 9 Drawing Sheets



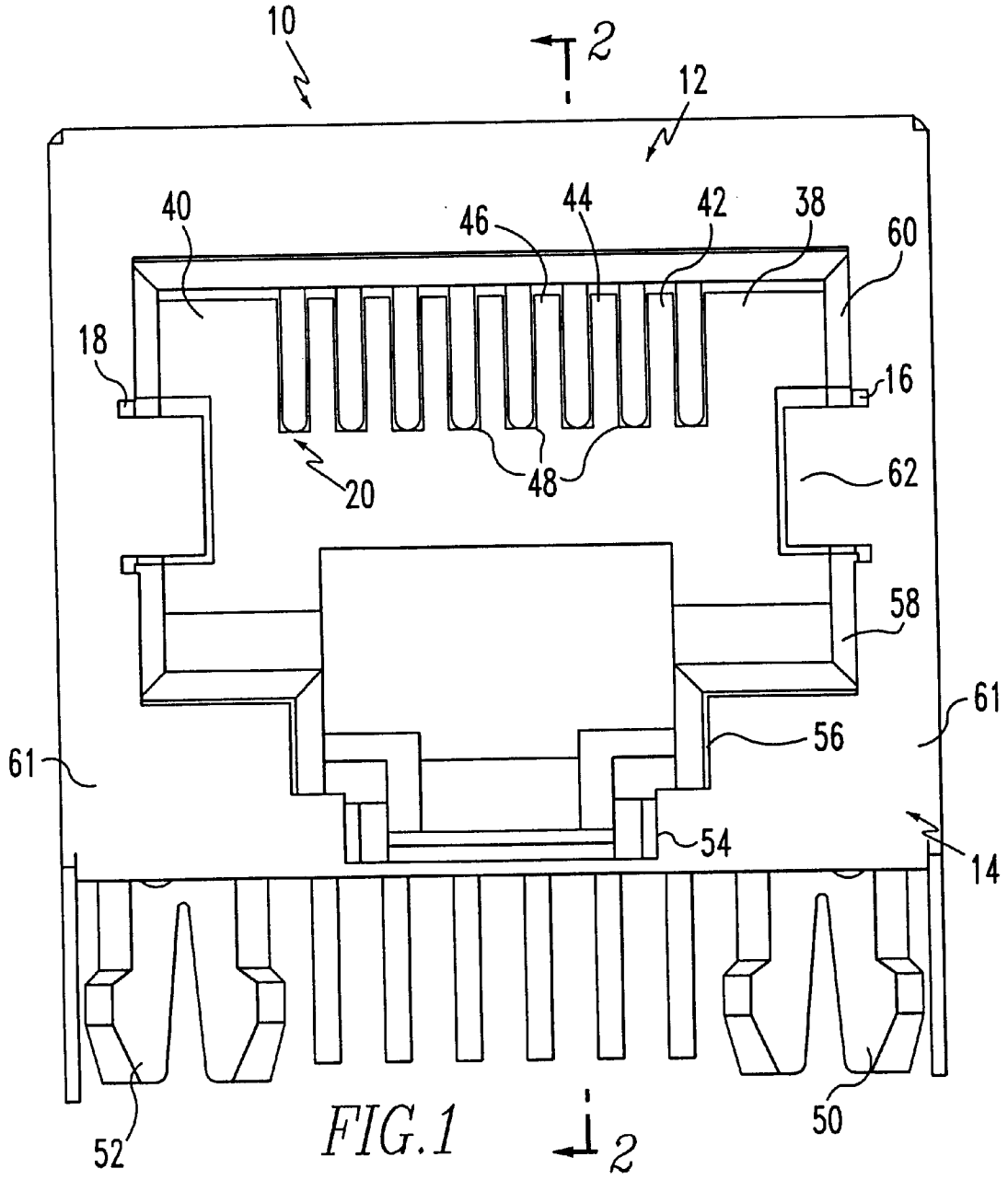
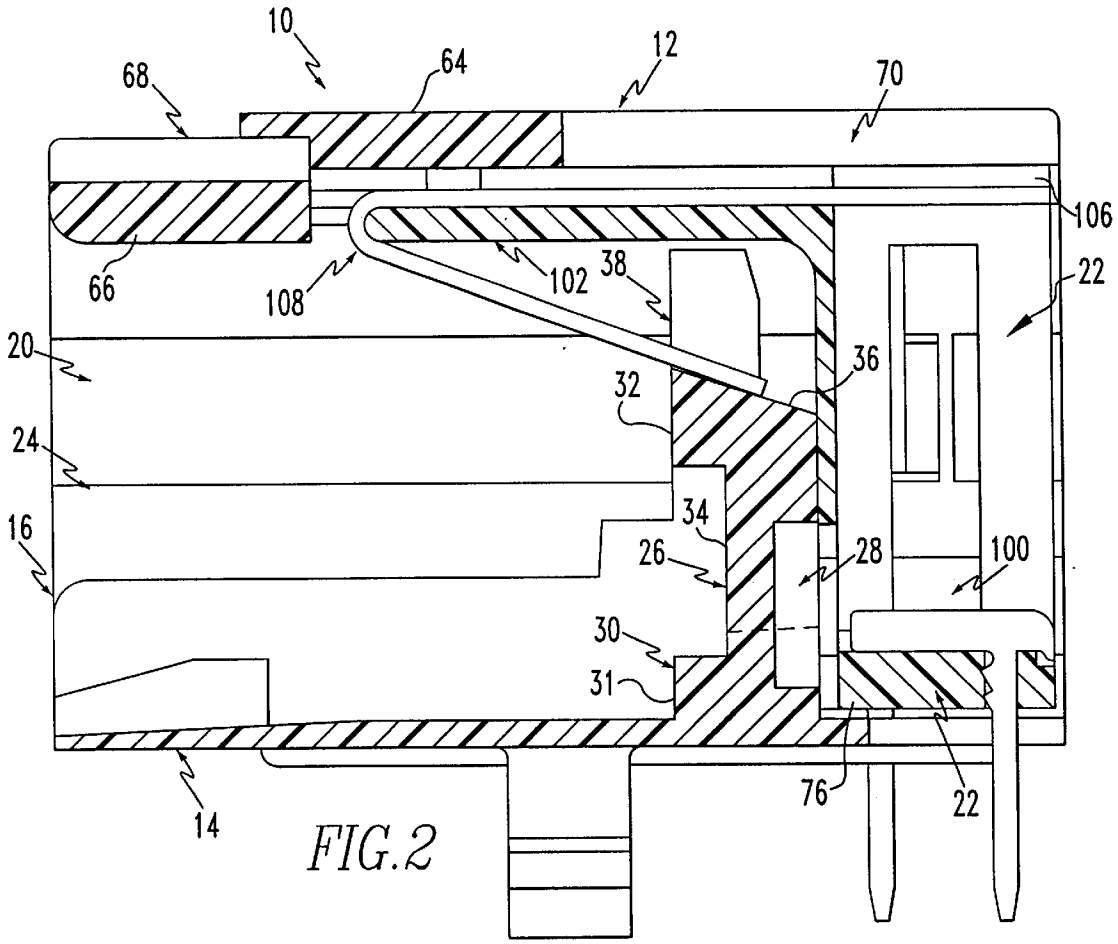


FIG.1


10
12
64
68
70
106
66
108
102
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22
20
36
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34
16
26
28
100
30
31
14
76
22

FIG.2

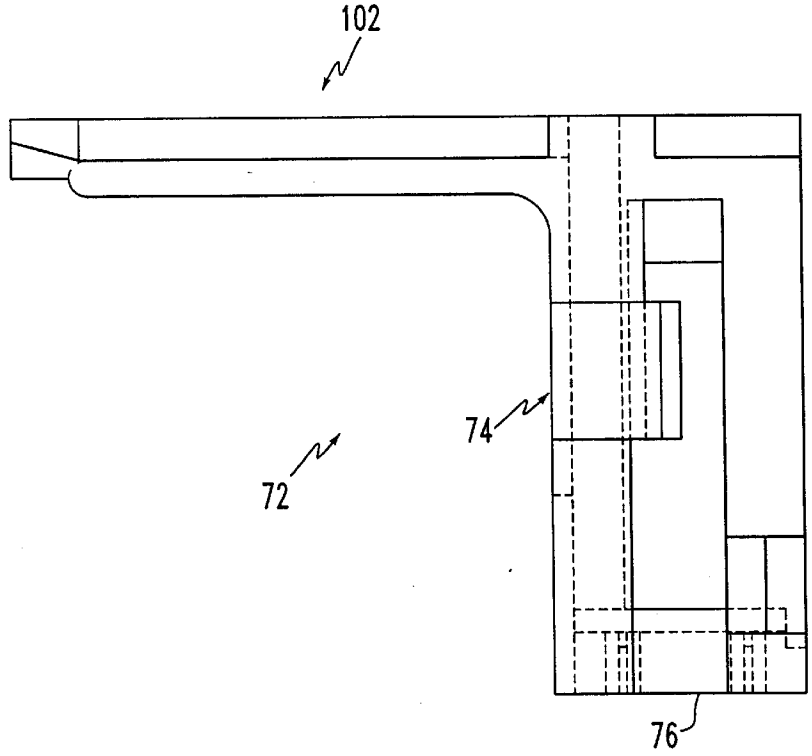


FIG. 3

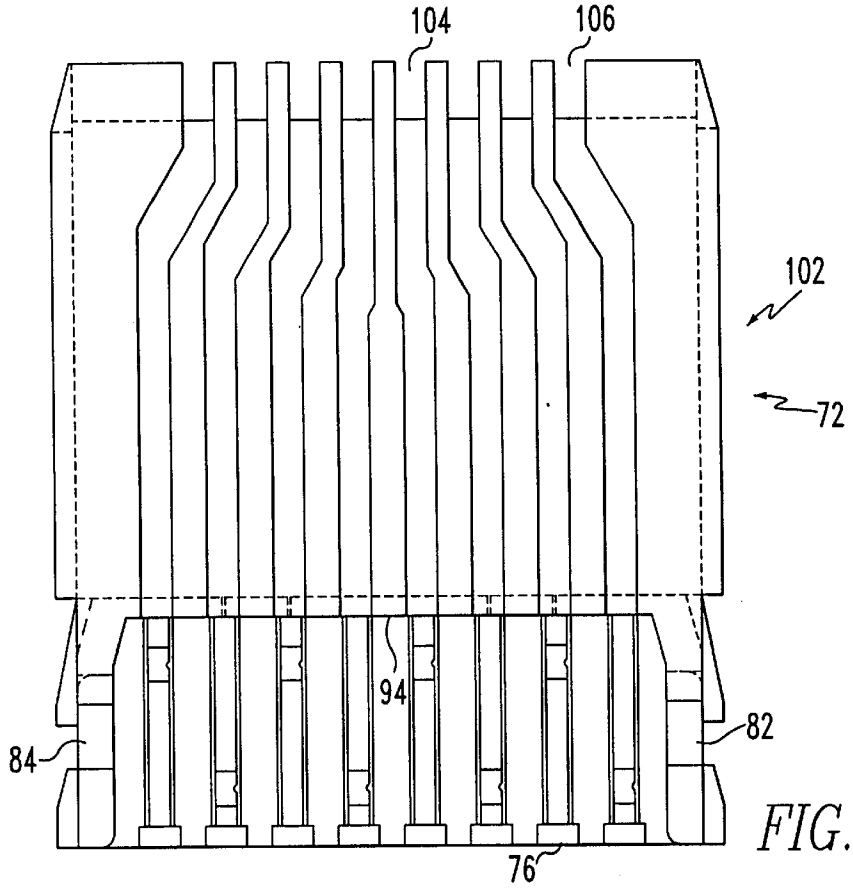
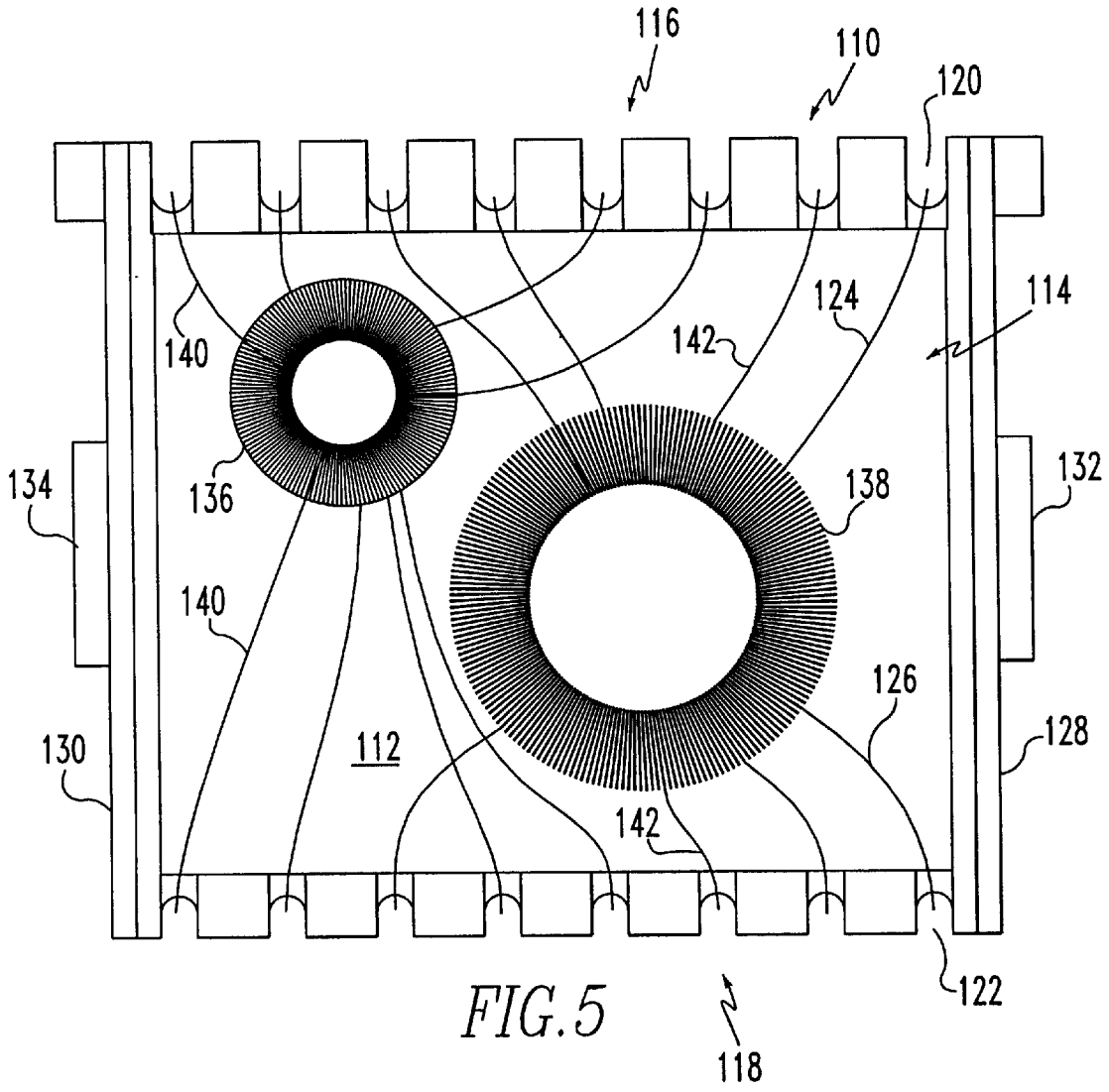


FIG. 4


116
110
120
114
124
142
140
136
134
138
132
140
126
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112
128
142
122
118

FIG. 5

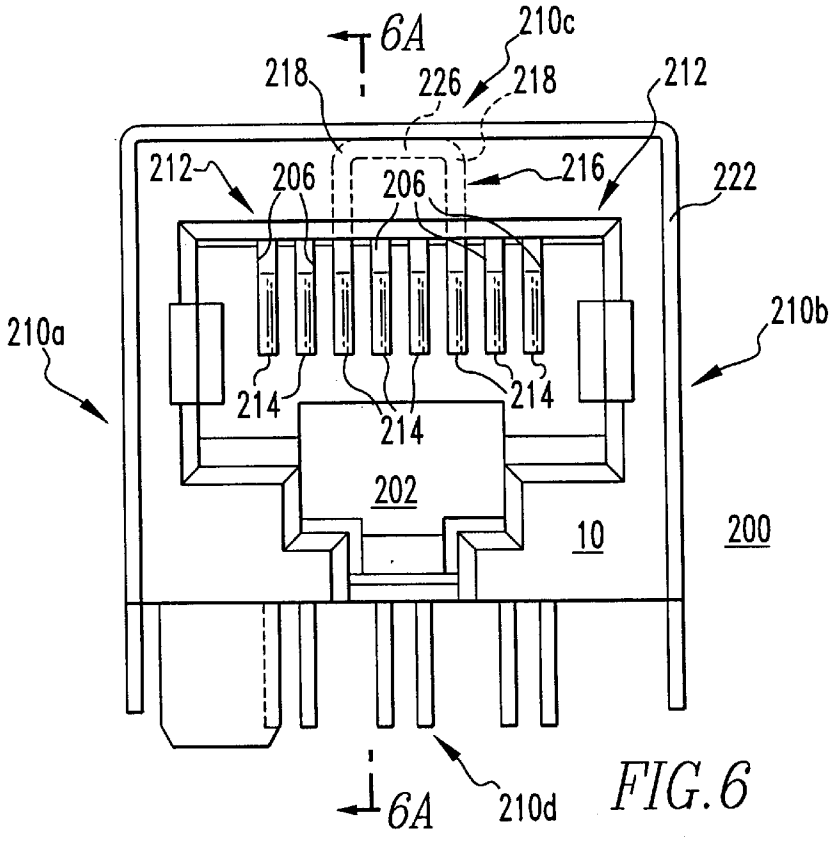
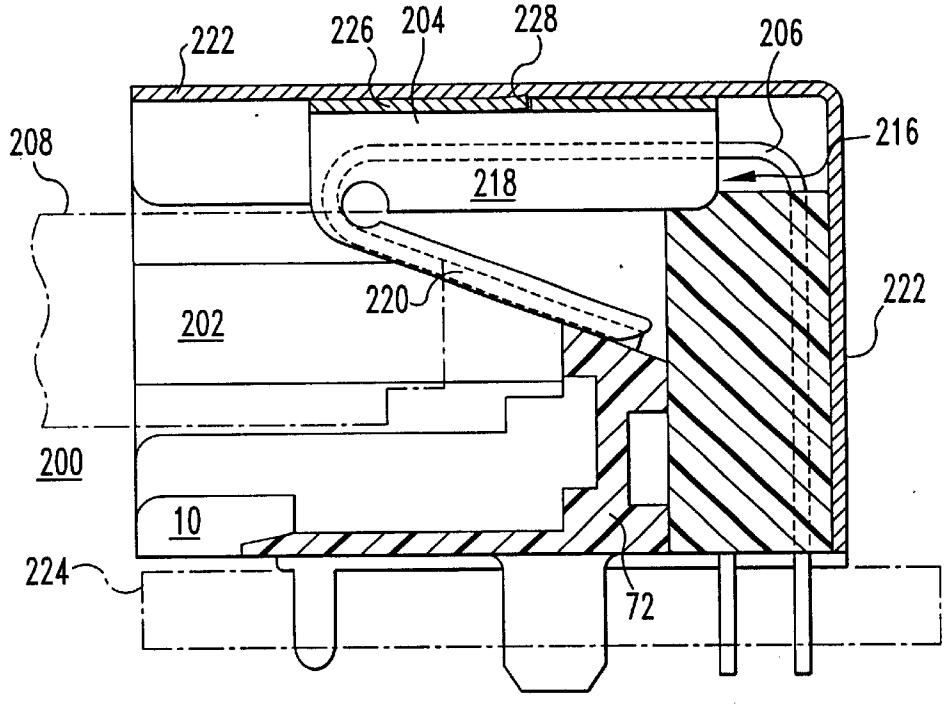

6A
210c
218
226
218
212
212
206
206
216
222
210a
210b
214
214
214
202
10
200
6A
210d

FIG. 6


222
226
204
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206
208
216
218
220
222
202
200
10
224
72

FIG. 6A

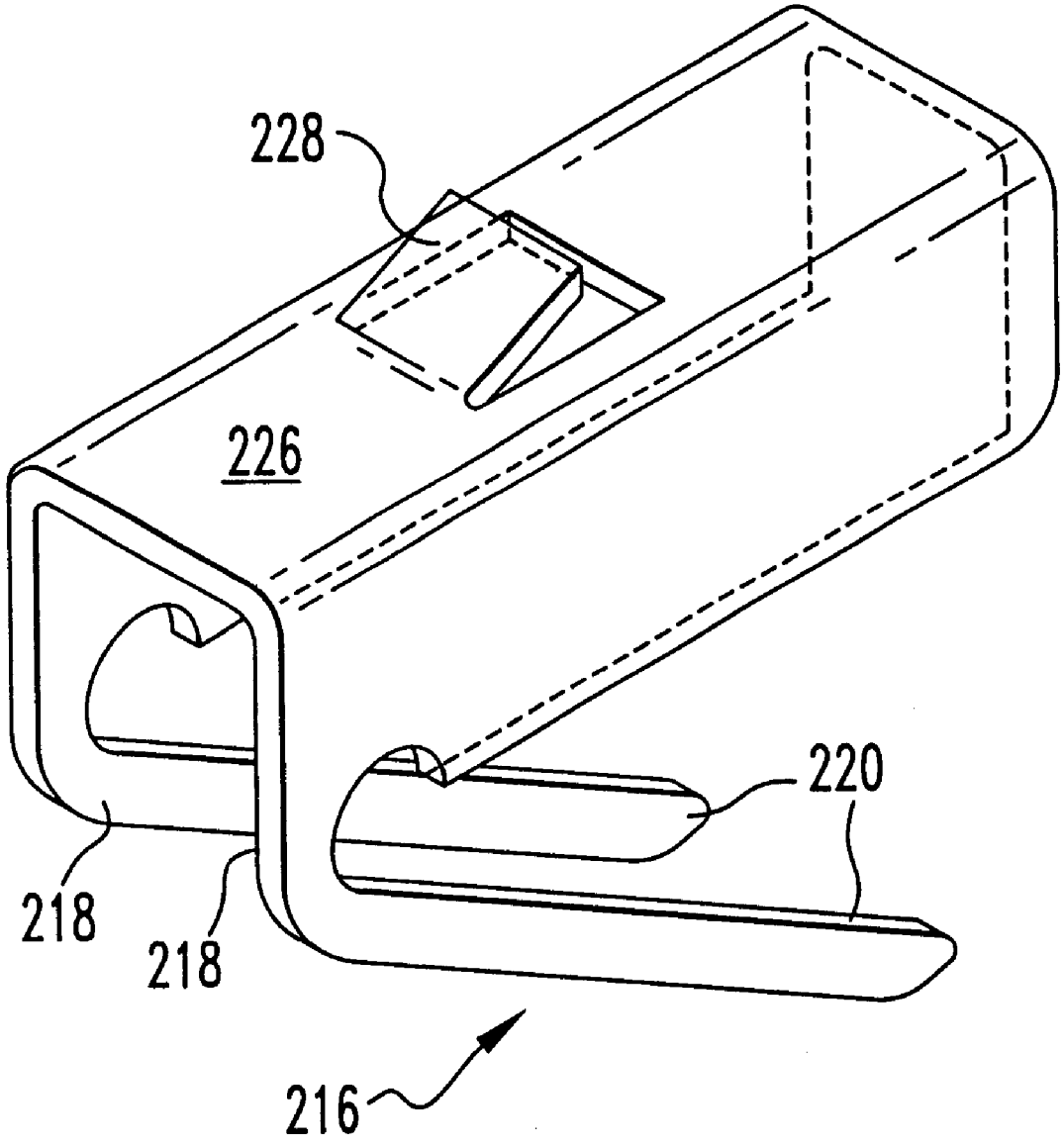

FIG. 6B

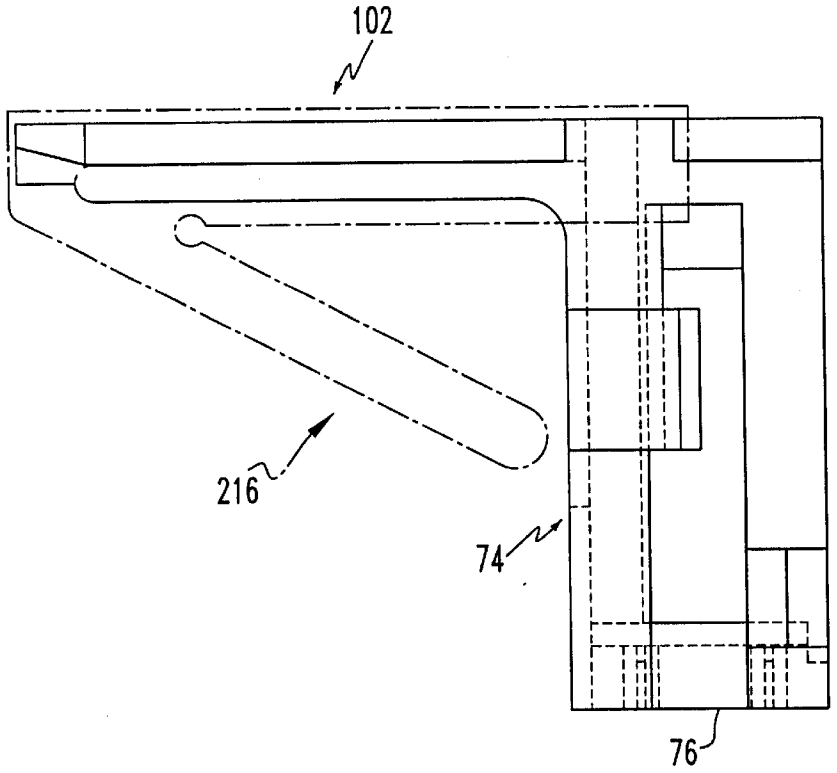

FIG. 6C

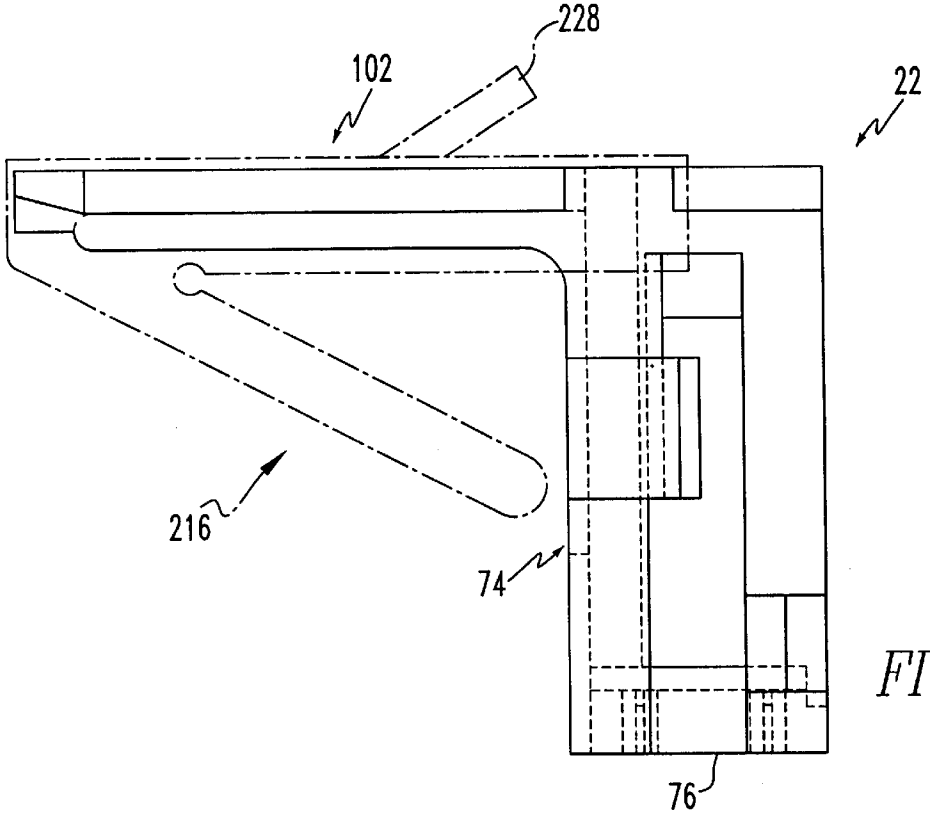

FIG. 6D

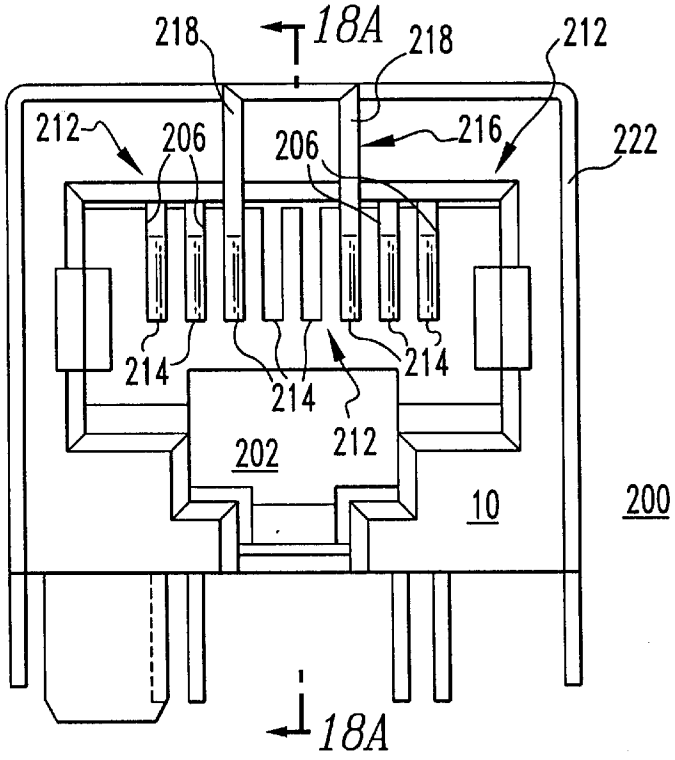
218
18A
218
212
212
206
206
216
222
214
214
214
212
202
10
200
18A

FIG. 7

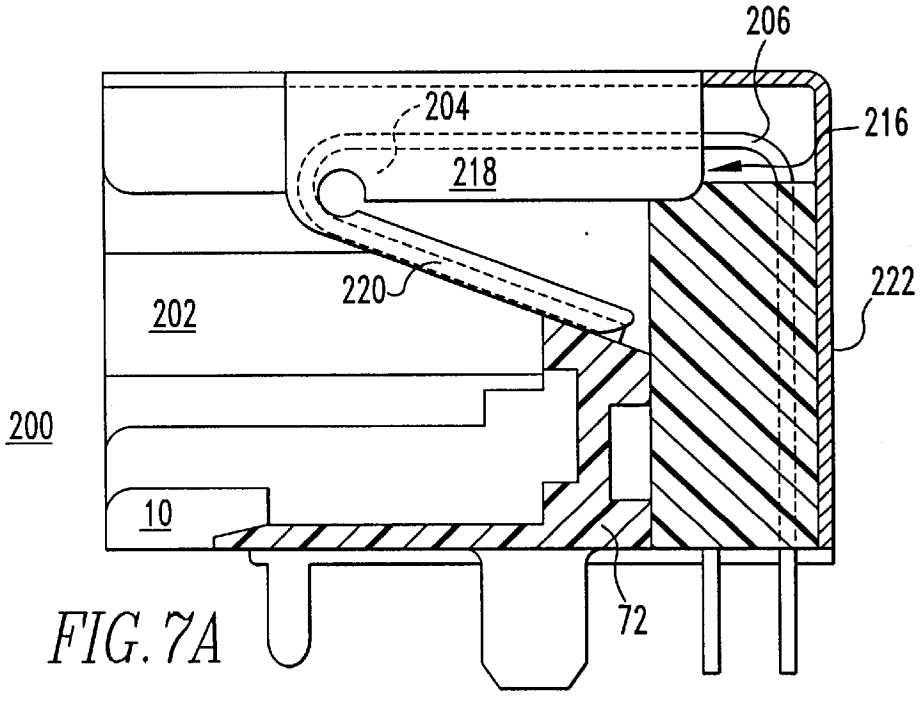
206
204
216
218
220
222
202
200
10
72

FIG. 7A

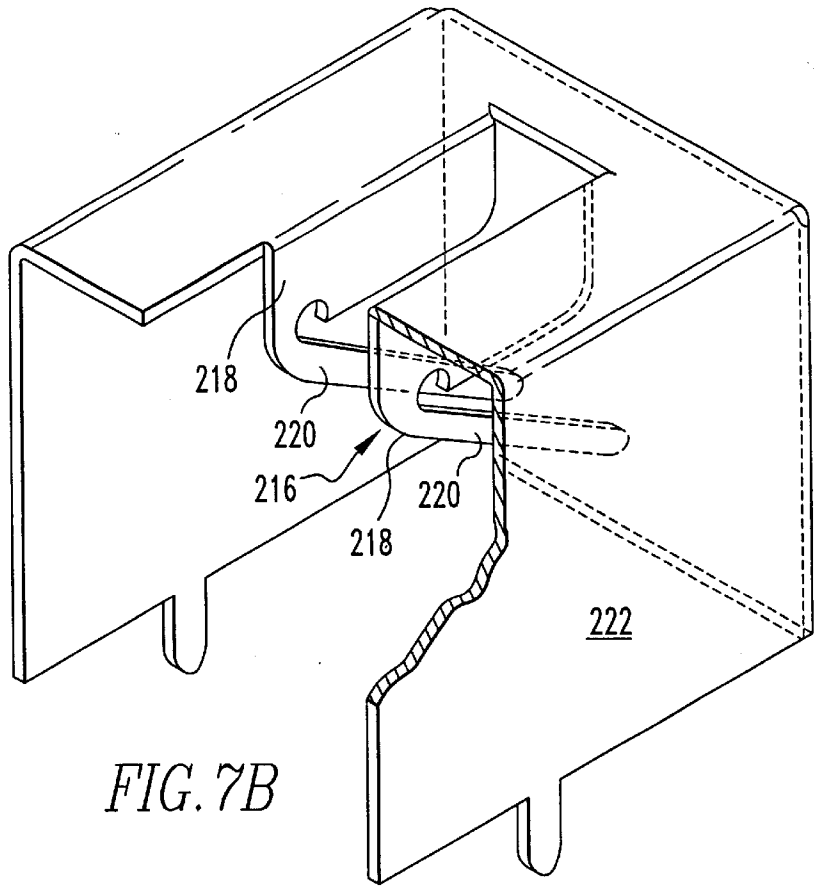

FIG. 7B

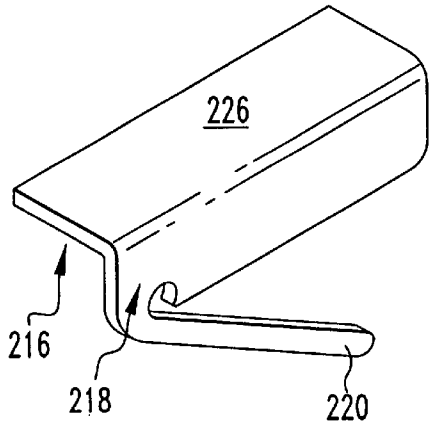

FIG. 8A

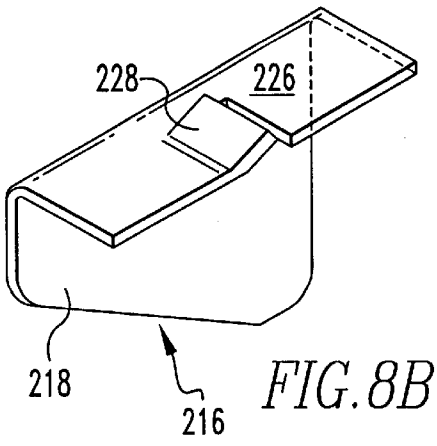

FIG. 8B

ELECTRICAL CONNECTOR WITH INTERNAL SHIELD

CROSS-REFERENCE TO RELATED APPLICATIONS

The present invention is related to U.S. patent application Ser. No. 09/419,734 filed on Oct. 16, 1999, herein incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an internal shield device for an electrical connector such as a modular jack. More particularly, the present invention relates to such an internal shield whereby groups of contacts within the jack are electrically shielded from one another.

2. Brief Description of Earlier Developments

Presently, a modular jack is almost universally employed as the input/output connector system for premises wiring (for example). Most voice and data communications equipment, including telephones, facsimile machines, modems, local networks, and switches utilize such modular jack connectors. In the jack, a plurality of contacts are arranged in a generally linear fashion in the jack interior. Initially, the performance of modular jacks limited their use to relatively lower speed applications, where cross-talk between signals on the contacts is not a significant issue.

However, a need has arisen for the jack connector in higher speed applications. As a result, various curative measures have been employed to address such cross-talk. For example, it is known that arranging contacts into contact pairs (signal and return) can reduce cross-talk. Likewise, various physical arrangements of contacts and pairs of contacts can reduce cross-talk, as can employing specific designs for each contact in a pair of contacts. In addition, filtering elements may be added to the connector.

A need still exists, though, for such an electrical connector that can adequately minimize cross-talk at relatively higher data speeds. Ideally, such connector should have a relatively simple design and should accept a conventional connector.

SUMMARY OF THE INVENTION

The aforementioned need is satisfied by the present invention, in which an electrical connector has an insulating housing with an interior cavity for receiving a mating connector and a plurality of openings in communication with the interior cavity. A plurality of contacts, each of which extends into the interior cavity of the housing from a respective one of the openings, electrically contacts conductors in the mating connector inserted into the interior cavity of the housing. An internal shield extends into the interior cavity from a respective one of the openings and is positioned between the plurality of contacts to create at least two groups of contacts.

In one embodiment of the present invention, a modular jack has an insulating housing with an interior cavity and generally opposing side faces, and an insulative insert with a forward portion, where the insert is mounted within the interior cavity of the insulating housing. A plurality of first contacts are mounted to the forward portion of the insert and extend into the interior cavity of the housing to electrically contact conductors in a connector inserted into the interior cavity of the housing and toward the forward portion of the insert.

Each first contact in the area of the forward portion generally resides in a plane generally parallel to the opposing side faces of the housing. The first contacts are organized into a plurality of groups, where each group comprises a number of immediately adjacent first contacts. The forward portion of the insert defines a number of possible contact positions within which each first contact may reside, and each group is separated from an immediately adjacent group by at least one unused contact position.

The jack also has a conductive internal shield device that includes at least one separator residing in an unused contact position and in a plane generally parallel to the plane of each first contact. Accordingly, the separator shields a pair of immediately adjacent groups from one another.

BRIEF DESCRIPTION OF THE DRAWINGS

The filtered modular jack assembly of the present invention is further described with reference to the accompanying drawings in which:

FIG. **1** is a front elevational view of one type of modular jack;

FIG. **2** is a cross sectional view through **2**—**2** in FIG. **1** in which for the purpose of showing other detail, shielding, a filter, and associated wires and a rear cap have been deleted;

FIG. **3** is a side elevational view of an insulative insert used in the modular jack shown in FIG. **1**;

FIG. **4** is a top plan view of the insulative insert shown in FIG. **3**;

FIG. **5** is an interior view of a cap element used in the modular jack shown in FIG. **1**;

FIG. **6** is a front elevational view of a modular jack with internal shield device in accordance with a first embodiment of the present invention;

FIG. **6**A is a cross-sectional view taken along the line **6**A—**6**A in FIG. **6**;

FIG. **6**B is a perspective view of the internal shield device of FIG. **6**;

FIGS. **6**C and **6**D are side elevational views of the insulative insert of the modular jack of FIG. **6** in variations on the first embodiment of the present invention;

FIG. **7** is a front elevational view of a modular jack with internal shield device in accordance with a second embodiment of the present invention;

FIG. **7**A is a cross-sectional view taken along the line **7**A—**7**A in FIG. **7**;

FIG. **7**B is a partially broken-away perspective view of the unitary internal shield device and external jack shield of FIG. **7**; and

FIGS. **8**A and **8**B are perspective views of internal shield devices employed in accordance with third and fourth embodiments of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. **1**–**5**, wherein like numerals are used to indicate like elements throughout, one type of modular jack is shown for purposes of disclosing typical features in modular jacks. As will be seen in FIGS. **6**–**8**B, wherein like numerals are also used to indicate like elements throughout, the modular jack of the present invention could share many common features with the modular jack shown in FIGS. **1**–**5**. The present invention, however, is not limited to use in the specific connector shown in the figures.

As seen in FIGS. **1** and **2**, the modular jack has an outer insulative housing which is shown generally at numeral **10**.

This housing includes a top wall **12**, a bottom wall **14** and a pair of opposed lateral walls **16** and **18**. The housing could be constructed of a thermoplastic polymer having suitable insulative properties and may have conventional metallic exterior shielding **61**. Within these walls is an interior section **20** which has a rear open end **22** and a forward open end **24**. Projecting upwardly from the bottom wall in this interior section there is a medial wall generally shown at numeral **26** which has a rear side **28** and a front side shown generally at numeral **30** which includes a bottom front side **31**, a top front side **32**, a recessed medial front side **34**, and an inclined top side **36** which slopes upwardly and forwardly from its rear side toward its front side. Adjacent to the lateral walls, the medial wall has lateral extensions **38** and **40** which serve as projections to retain other elements as will be hereafter explained. Interposed between these lateral extensions there are a plurality of wire separation extensions as at **42**, **44** and **46** and between these wire separation extensions there are plurality of slots as at **48**.

As will be appreciated by those skilled in the art and as further explained hereafter, the wall and recesses of the outer insulative housing may interact to receive an insulative insert **72** (best seen in FIGS. **3** and **4**). One type of insert (such as the insert shown in FIG. **6**C) includes all of the terminals used by the modular jack. In the modular jack shown in FIGS. **1–5**, however, housing **10** has terminals that correspond to the terminals on insert **72** so as to make electrical connection between the conductors in the housing **10** and the insert **72**. Importantly, the housing **10** and the insert **72**, rather than being separate elements, may be formed as a substantially unitary body without departing from the spirit and scope of the present invention.

Extending downwardly from the bottom wall there are alignment and retention posts **50** and **52** for mounting to a PCB. The lateral wall **16** includes a lower shoulder **54**, another shoulder **56**, a lower main wall **58**, an upper main wall **60** and a recess interposed between the lower and upper main wall that accepts a tab **62** from external shield **61** when the insertion of a plug (FIG. **6**A) into the modular jack receptacle deflects tab **62**. It will be seen that the lateral wall **18** has substantially identical features as lateral wall **16**. The top wall **12** includes an upper bridge section **64**, a lower bridge section **66**, a front recess **68** and a rear recess **70**.

Referring particularly to FIGS. **3** and **4**, the insulative insert which may be received by the housing **10** is shown generally at numeral **72**. This insert **72** has a vertical section shown generally at numeral **74** which includes a base wall **76**. The vertical section also includes opposed side walls **82** and **84**. The vertical section also has a front wall **94** in which there are apertures **96** and **98**. Finally the vertical section **74** of the insert **72** could define a recess **100**. The insert also has a horizontal section shown generally at numeral **102** which has a plurality of grooves as at groove **104** and **106** which extend from the rear to the front of this horizontal section. In these grooves there are conductors as at wire **108** (FIG. **2**).

Referring particularly to FIG. **5**, a cap element which may be mounted to the insert **72** is shown generally at numeral **110**. This cap element **110** has a rear wall **112** and defines a recess **114** therein. The cap also has a top end wall **116** and a bottom end wall **118** which have respectively grooves as at groove **120** and **122**. Conductors as at wire **124** and **126** are positioned in each of these grooves. The cap also has side walls **128** and **130** which have respectively latches **132** and **134** for engaging the side walls **82** and **84** of the insulative insert. A filter means such as common mode chokes **136** and **138** may be mounted on the inner or recess side of the wall **112**, as is more fully discussed in U.S. patent application Ser. No. 08/863,654, hereby incorporated by reference. Other filtering elements known to those skilled in the art such as inductive serial filters, differential filters, low pass capacitive filters and other magnetic filters may be substituted for the common mode choke. It will be appreciated that in the modular jack as shown in FIGS. **1–5**, each groove **104**, **106** in the horizontal section **102** of the insert **72** is filled with a wire or first contact **108**, for a total of eight first contacts **108** arranged in a generally linear manner in a highly compact space. Referring now to FIGS. **6–8**B, it is seen that in contrast to the jack of FIGS. **1–5**, the jack of the present invention includes a number of unused grooves or contact positions, where the unused contact positions define borders or buffers between a number of groups of first contacts. In the present invention, cross-talk between such groups is minimized by placing a conductive internal shield device in an unused contact position, whereby the separator shields a pair of immediately adjacent groups from one another. In empirical tests, it has been found that the reduction in cross-talk using such internal shield is so significant that at least some other typically employed cross-talk remedies may be dispensed with.

The modular jack **200** of the present invention could be similar to the jack shown in FIGS. **1–5** in that such jack **200** has an insert (FIG. **6**C) mounted within an interior cavity **202** of an insulating housing **10**. In such a situation, the insert may define a recess for receiving a filter element or the like therein, although such recess and filter or the like are not necessary in terms of the present invention. Furthermore, even the use of a separate insert is unnecessary to carry out the present invention. The present invention could also be used in a single piece housing.

In terms of the embodiments shown, the insert **72** may be defined to include a forward portion **204** (i.e., the horizontal section **102** in FIGS. **1–5**, generally), and a plurality of first contacts **206** are mounted to the forward portion **204** of the insert **72** and extend into the interior cavity **202** of the housing **10**. However, other arrangements are possible. The first contacts **206**, as is to be understood, are for electrically contacting corresponding conductors (not shown) in a connector **208**, such as a plug having a plurality of conductors therein, when such connector **208** is properly inserted into the interior cavity **202** of the housing **10** and toward the forward portion **204** of the insert **72**.

As seen in FIGS. **6** and **6**A, the housing **10** and jack **200** have generally opposing side faces **210***a*, **210***b*, and generally opposing upper and lower faces **210***c*, **210***d* that generally interconnect the side faces **210***a*, **210***b*. As also seen, each first contact **206** in the area of the forward portion **204** generally resides in a plane generally parallel to the opposing side faces **210***a*, **210***b*. Any type of appropriate first contact **206** may be employed in the jack **200** without departing from the spirit and scope of the present invention, as long as the employed first contact **206** is capable of performing the necessary functions as described herein.

For example, the first contacts **206** may be so-called 'long' first contacts **206** that, beginning with the mating end, extend from beneath the forward portion **204** of the insert **72** up and over to the top side of the forward portion **204**, and then to the rear of the jack **200**, as is seen in FIG. **6**A. Likewise, the first contacts **206** may be so-called 'short' first contacts **206** that, beginning with the mating end, extend from above the forward portion **204** of the insert **72** down and around to the bottom side of the forward portion **204**, and then to the rear of the jack **200** (not shown). Moreover, multiple types of first contacts **206**, including long, short,

and other varieties, may be employed simultaneously, again without departing from the spirit and scope of the present invention. U.S. Pat. No. 5,687,478, herein incorporated by reference, describes the use of 'long' and 'short' contacts in a modular jack receptacle.

As best seen in FIG. **6**, the. first contacts **206** are organized into a plurality of groups **212**, where each group **212** comprises a number of immediately adjacent first contacts **206**. Each group may have a like number of first contacts **206**, or may likewise have a different number of first contacts. Moreover, the number of first contacts **206** in a group may be as little as one, although it is more typical that such groups will have at least two first contacts **206**. As shown, the forward portion **204** of the insert **72** defines a number of possible contact positions **214** within which each first contact **206** may reside. Importantly, not all of the contacts positions **214** are loaded with contacts **206**. Accordingly, at least one of the possible contact positions **214** is unused or unoccupied by a first contact **206** (two are unoccupied by contacts as seen in FIG. **6**). Preferably, each group **212** is separated from an immediately adjacent group **212** by at least one unused contact position **214**. The unused positions can be loaded with a shield as described in more detail below.

In one embodiment of the present invention, each possible contact position **214** is embodied as a contact channel **214** in the top side of the forward portion **204** of the insert **72**. Eight such contact channels **214** are shown in FIG. **6**. As seen, each contact channel **214** extends generally parallel to the opposing side faces **210***a*, **210***b* of the housing **10**, as well as generally parallel to the upper and lower faces **210***c*, **210***d* of such housing **10**. As should be evident, each contact channel **214** can receive (although does not necessarily receive) at least a portion of a first contact **206** (i.e. a 'long' contact) therein.

As should be evident, then, if the jack **200** of the present invention has X contact positions **214** and Y groups **212**, such jack **200** can accommodate a maximum of X−Y+1 first contacts **206**. Of course, the jack **200** could be loaded with a lesser amount of contacts **206** without departing from the spirit and scope of the present invention, in which case additional unused contact positions **214** are present.

Importantly, to minimize cross-talk in the present invention, each group **212** is shielded from an immediately adjacent group **212** by a conductive internal shield device **216** which includes at least one separator **218**, as is seen in FIGS. **6**–**6**B (where the shield device **216** has two separators **218**). Preferably, the shield device **216** is formed from a conductive shielding material such as a copper alloy, although any other appropriate conductive shield material may also be employed. It is expected that the shield device **216** will be created by one or more stamping, folding and/or forming operations, although other methods may also be employed. For example, the shield device **216** may be extruded or molded into its final form.

As shown, each separator **218** of the shield device **216** resides in an unused contact position **214** and is positioned to be in a plane generally parallel to the plane of each first contact **206** in the jack **200**. In other words, separator **218** mimics a contact placed in the unused contact positions. Separator could engage a corresponding conductor in plug **208**, or merely reside within a channel lacking a conductor. Accordingly, each separator **218** in fact performs the aforementioned shielding function, electromagnetic interference generated by a group **212** on side of the separator **218** is prevented from substantially affecting a group **212** on the other side of the separator **218**, and cross-talk is thus minimized.

Typically, the shield device **216** is inserted into the jack **200** by inserting each separator **218** thereof down through the upper face **210***c* of the housing **10**/jack **200** and into and through the corresponding unused contact position **214** in a direction generally perpendicular to the extending contact channels **214**. Accordingly, a separator receiving slot (not shown) must be present in the region of such corresponding unused contact position **214**. As maybe appreciated, such slot may reside in the insert **72**, the housing **10**, or both the insert **72** and the housing **10**. In one embodiment of the present invention, such slot is formed during the formation of the housing **10** and/or the insert **72**. In another embodiment, the slot is formed after such formation by appropriate machining in a known manner. Owing to the fact that each groove **104**, **106** in the insert **72** may have a non-linear aspect at the top face thereof, as is seen in FIG. **4**, each slot is referenced to a respective groove **104**, **106**, but need not necessarily be precisely aligned with such groove **104**, **106** at such top face.

In one possible application of the present invention, then, and as seen in FIGS. **6**–**6**B, if eight contact positions **214** are available, if positions 3 and 6 (as numbered from left to right) are designated as receiving separators **218**, then three groups **212** of first contacts **206** (C) are available in the jack **200**: a first group at 1–2, a second group at 4–5, and a third group at 7–8 in the following arrangement:

1	2	3	4	5	6	7	8
C_{short}	C_{long}	S	C_{short}	C_{long}	S	C_{short}	C_{long}

Preferably, each group **212** of contacts has one 'short' contact (C_{short}) and one 'long' contact (C_{long}). However, other contact arrangements are possible.

Furthermore, separators **218** need not create a symmetrical arrangement. For example, the following arrangement is one possibility:

1	2	3	4	5	6	7	8
C_{short}	S	C_{long}	C_{long}	C_{long}	S	C_{long}	C_{long}

In this instance, all of the contacts could be long contacts.

As best seen in FIGS. **6**A–**6**B, the planar extent of each separator **218** need not necessarily be especially large to achieve the aforementioned shielding function. Instead, and as shown, the separator **218** need only extend planarly enough to substantially minimize if not completely remove direct 'line of sight' interaction between corresponding portions of the first contacts **206** on either side of such separator **218**. Thus, if the separated first contacts **206** each have a first portion on top of the forward portion **204** of the insert **72**, a second, connecting portion curving around the forward portion **204**, and a third portion below the forward portion **204**, then the separating separator **218** preferably has portions corresponding to such first, second, and third portions, as is shown.

Typically, each first contact **206** in the jack is springed in the area where contact is to be made with a corresponding conductor (not shown) of a connector **208** to be received in the jack **200**, where the springed portion corresponds to the third portion below the forward portion **204** of the insert **72**, as was discussed above. As is to be understood, the springed portion of each first contact **206** allows for springing contact with the corresponding conductor, thereby spring-loading such springed portion and minimizing the chance that such conductor is damaged by such contact, among other things.

As should be understood, each separator **218** will also make contact with a corresponding conductor (not shown) of such connector **208**. Accordingly, in one embodiment of the present invention, each separator **218** of the shield device **216** has a springed portion **220** corresponding to the springed portion of each first contact **206**. Thus, like the springed portion of each first contact **206**, the springed portion **220** of each separator **218** allows for springing contact with the corresponding conductor, thereby spring-loading the springed portion **220** of the separator **218** and minimizing the chance that such conductor is damaged by such contact, among other things. Such springed portion may be unnecessary, for example, if the mating connector **208** lacks a corresponding conductor, or if a different conductor is employed to engage the internal shield **216**.

In one embodiment of the present invention, and as seen in FIGS. **6**–**6**B, the jack **200** has a conductive external jack shield **222** that is fitted over the housing **10**. As is to be understood, the jack shield **222** substantially shields the jack **200** from externally originating electromagnetic interference, and also shields the exterior of the jack **200** from electromagnetic interference that originates from within the jack **200**. Preferably, the jack shield **222** is formed from a conductive shielding material such as a copper alloy, although any other appropriate conductive shield material may also be employed. It is expected that the jack shield **222** will be assembled by one or more stamping, forming, and/or folding operations, although other assembling methods may also be employed. For example, the jack shield **222** may be extruded or molded into its final form.

Preferably, the jack shield **222** is electrically grounded by way of an underlying substrate **224** (FIG. **6**A), and the shield device **216** is in conductive contact with the jack shield **222**. Accordingly, the shield device **216** and each separator **218** thereof is also electrically grounded.

In one embodiment of the present invention, and as seen in FIGS. **6**–**6**B, the shield device **216** includes a base member **226** coupled to each separator **218**, where the base member **226** generally resides in a plane generally parallel to the upper and lower faces **210***c*, **210***d* of the housing **10**/jack **200**, and is generally perpendicular with respect to each attached separator **218**. Accordingly, when the shield device **216** is pushed down into the upper face **210***c* of the housing **10**/jack **200**, the base member **226** generally overlays at least one of the contact positions **214** in the insert **72**.

In one embodiment of the present invention, the base member **226** of the shield device **216** is generally positioned at the upper face **210***c* of the jack **200**/housing **10**. To accommodate the base member **226**, a receiving space is preferably formed in the housing **10**, insert **72**, or both, either during the formation of the housing **10** and/or the insert **72**, or else after such formation by appropriate machining in a known manner.

With the shielding device **216** having the base member **226** properly inserted into the housing **10**/jack **200**, and the base member **226** at the upper face **210***c*, the aforementioned conductive external jack shield **222** may then be fitted over the housing **10** such that the base member **226** of the shield device **216** is in conductive contact with the jack shield **222**. In one embodiment of the present invention, the base member **226** of the shield device **216** includes a projection **228** projecting from the upper face **210***c* toward the jack shield **222** to ensure contact therewith. Preferably, to ensure that a good quality contact is achieved, the projection **228** is springed, whereby contact between the springed projection **228** and the jack shield **222** spring-loads such springed projection **228**. The projection **228** may be formed by any appropriate method. For example, the projection **228** may be stamped from the shield device **216** during formation of such shield device **216**.

In a variation on the embodiment of the present invention shown in FIGS. **6**–**6**B, and as seen in FIG. **6**C, the shield device **216** (shown in phantom) is inserted down through the insert **72** of the jack **200** only, and not through the housing **10**. As should be understood, such a situation may require that the shield device **216** be inserted into the insert **72** prior to insertion of the insert **72** into the housing **10**. In another variation on the embodiment of the present invention shown in FIGS. **6**–**6**B, and as seen in FIG. **6**D, the shield device **216** (shown in phantom) is inserted from the rear face of the insert **72** thereinto, and again not through the housing **10**. As should be understood, in such a situation, the base member **226** would face toward the rear of the insert **72** and jack **200**, rather than toward the upper face as in FIGS. **6**–**6**C. In the variations shown in FIGS. **6**C and **6**D, each shield device **216** may be provided with a suitable projection **228** (shown in FIG. **6**D) to contact a jack shield **222**. Such a suitable projection **228** may however require suitable access through the corresponding insert **72** and/or housing **10** if such jack shield **222** is not physically adjacent any part of the shield device **216**.

Referring now to FIGS. **7**–**7**B, it is seen that in a second embodiment of the present invention, the external jack shield **222** and the internal shield device **216** are formed as a substantially unitary body by an appropriate stamping and forming operation, and are thus mounted to the jack **200** as the substantially unitary body. Notably, in the jack **200** shown in FIGS. **7**–**7**B, no base member **226** is present as the separators **218** are coupled directly to the jack shield **222**. Likewise, no projection **228** is present.

In one possible application of the present invention, then, and as seen in FIGS. **7**–**7**B, if eight contact positions **214** are available, if positions 4 and 5 (as numbered from left to right) are designated as unused by either contacts or separators, if two separators **218** (appropriately spaced) are inserted into slots 3 and 6, then two groups **212** of first contacts **206** are available in the jack **200**: a first group at 1–2 and a second group at 7–8. Importantly, since the jack shield **222** exposes contact positions 4 and 5, contact positions 4 and 5 are not shielded by the jack shield **222**, and therefore positions 4 and 5 are not loaded. As shown in FIGS. **7**–**7**B, then, each group **212** is separated from the other by four immediately adjacent unused contact positions **214**, and each separator **218** resides in an unused contact position **214** immediately adjacent a respective group **212**. As specifically shown in FIGS. **7** and **7***a*, contacts **206** are long contacts and the arrangement is as follows:

1	2	3	4	5	6	7	8
C_{long}	C_{long}	S	—	—	S	C_{long}	C_{long}

If jack **200** used long and short contacts, then a possible arrangement could be as follows:

1	2	3	4	5	6	7	8
C_{long}	C_{long}	S	—	—	S	C_{long}	C_{long}

If, however, contact positions 4 and 5 were shielded by the jack shield **222** by appropriate shielding (such as, for example, shield **222** was stamped and formed in a different manner so as to provide shielding over positions 4 and 5),

such positions could be loaded with contacts **206** to form another group **212**.

Referring now to FIGS. **8**A and **8**B, in third and fourth embodiments of the present invention, the shield device **216** need only have a single separator **218** attached to a base member **226** (FIGS. **8**A and **8**B), the projection **228** need not necessarily be employed (FIG. **8**A), and the separator **218** need not necessarily be springed (FIG. **8**B). Of course, with only a single separator **218**, only two groups **212** can be formed thereby. The present invention could use, however, more than one of individual separators shown in FIGS. **8**A and **8**B.

As shown in FIGS. **8**A and **8**B, the base member **226** of the single separator shield device **216** may extend toward either side face **210***a*, **210***b* (FIG. **8**A, FIG. **8**B, respectively) from the separator **218**), depending on convenience and based on which contact position **214** the separator is to be positioned in. For example, if the separator **218** is to be in contact position 3, having the base member overlay at least contact position 4 (by using the shield device **216** of FIG. **8**B) is most likely desired.

As should now be understood, practically any appropriate shielded arrangement may be employed. For example, if eight contact positions **214** are available, if position **3** (as numbered from left to right) receives a separator **218**, then two groups **212** of first contacts **206** are available in the jack **200**: a first group at **1–2** and a second group at **4–5–6–7–8**. Several possible arrangements are shown below:

1	2	3	4	5	6	7	8
C_{short}	C_{long}	S	C_{long}	C_{short}	C_{short}	C_{long}	C_{long}
C_{long}	C_{long}	S	C_{long}	C_{long}	C_{short}	C_{long}	C_{long}

In the present invention, a jack **200** can receive a shield device **216**, thereby forming a plurality of shielded contact groups **212** therein where cross-talk between such groups **212** is minimized. Such jack **200** with such shielded contact groups **212** may then be employed in a relatively high speed application. While the present invention has been described in connection with the embodiments as shown in FIGS. **6–8**B, it is to be understood that other similar embodiments may be used or modifications and additions may be made to the described embodiments for performing the same function of the present invention without deviating therefrom. Therefore, the present invention should not be limited to any single embodiment, but rather construed in breadth and scope in accordance with the recitation of the appended claims.

What is claimed is:

1. An electrical connector comprising:

an insulating housing having an interior cavity for receiving a mating connector and a plurality of openings in communication with the interior cavity;

a plurality of contacts, each extending into the interior cavity of the housing from a respective one of the openings, for electrically contacting conductors in the mating connector inserted into the interior cavity of the housing; and

an internal shield extending into the interior cavity and between the contacts to separate the contacts into a plurality of groups.

2. The connector of claim **1**, wherein the internal shield separates the contacts into at least three groups.

3. The connector of claim **1** wherein the plurality of openings are generally parallel.

4. The connector of claim **1** wherein the internal shield includes two separators, each separator residing in an unused contact position immediately adjacent a respective group.

5. The connector of claim **1** wherein the internal shield includes a resilient section engaged by the mating connector during insertion thereof into the cavity.

6. The connector of claim **1** wherein the housing includes a removable insert positioned therein.

7. The connector of claim **1** wherein the connector is a modular jack.

8. The connector as recited in claim **1**, wherein the internal shield extends into the interior cavity from at least one of the openings.

9. The connector of claim **1** further comprising an external shield generally surrounding the housing.

10. The connector of claim **9** wherein the external shield is in conductive contact with the internal shield.

11. The connector of claim **10** wherein the external shield and the internal shield are formed as a substantially unitary body.

12. The connector of claim **1** wherein the housing further has an upper face and wherein the internal shield includes a base member located adjacent the upper face and at least one separator extending from the base member and into the interior cavity.

13. The connector of claim **12** wherein the base member includes a projection projecting away from the housing.

14. A modular jack comprising:

an insulating housing having an interior cavity;

a plurality of contacts extending into the interior cavity of the housing for electrically contacting conductors in a mating connector inserted into the interior cavity of the housing, each contact having a mating portion, and the contacts being organized into a plurality of groups, each group comprising a number of immediately adjacent contacts, each group being separated from an immediately adjacent group by at least one unused contact position; and

a conductive internal shield residing in the at least one unused contact position and being generally aligned with the mating portions of the contacts, to shield the immediately adjacent groups from one another.

15. The jack of claim **14** wherein the internal shield resides in a plurality of unused contact positions.

16. The jack of claim **14** wherein the internal shield resides in at least two unused contact positions.

17. The jack of claim **14** further comprising a conductive external shield fitted over the housing, the internal shield being in conductive contact with the external shield.

18. The jack of claim **17** wherein the external shield and the internal shield are formed as a substantially unitary body.

19. The jack as recited in claim **14**, wherein the insert is generally L-shaped with a rear section and an upper section transverse to the rear section, the internal shield residing on the upper section.

20. The jack of claim **23** wherein the contacts are organized into at least two groups, each group comprising a pair of immediately adjacent contacts, each group being separated from the other by at least one unused contact position, and wherein the internal shield resides in an unused contact position between the groups.

21. The jack of claim **14** wherein the housing comprises a base and an insert receivable in the base, the insert carrying the contacts.

22. The jack of claim 21, wherein the insert carries the internal shield.

23. The jack of claim 14 wherein the housing defines eight possible contact channels.

24. The jack of claim 14 wherein the internal shield comprises at least one separator extending into the interior of the housing and a base member coupled to each separator, the base member being generally parallel to an upper face of the housing.

25. The jack of claim 24 further comprising a conductive external shield fitted over the housing, the base member of the internal shield being in conductive contact with the external shield.

26. The jack of claim 25 wherein the base member of the internal shield includes a projection extending toward the external shield to ensure contact therewith.

27. An electrical connector system, comprising:

a plug connector, including:

a housing having a plurality of openings therein; and

a plurality of contacts disposed in at least some of said openings; and

a receptacle connector, including:

a housing having a cavity for receiving said plug;

a plurality of terminals, each extending into said cavity for engaging a corresponding one of said plurality of plug contacts; and

a shield extending into said cavity and entering at least one of said plurality of openings during mating.

28. The electrical connector system as recited in claim 27 wherein said plug and receptacle connectors are modular jack plug and receptacle connectors.

29. The electrical connector system as recited in claim 27 wherein said shield includes a resilient section deflected by said plug connector during mating.

30. The electrical connector system as recited in claim 27, wherein the shield extends into at least one unused contact position located between adjacent contacts.

31. The electrical connector system as recited in claim 27 wherein said shield engages a corresponding one of said plurality of plug contacts during mating.

32. The electrical connector system as recited in claim 27 wherein said cavity of said receptacle connector includes latch structure and said plug connector includes a latch that engages said latch structure for retaining said plug connector within said receptacle connector.

33. The electrical connector system as recited in claim 27 wherein said receptacle connector further comprises an external shield generally surrounding said housing.

34. The electrical connector system as recited in claim 33, wherein the shield and the exterior shield are unitary.

35. An electrical connector comprising:

a housing having:

an interior cavity;

a mating face having an opening in communication with the interior cavity to allow entry of a mating connector into the interior cavity; and

a face transverse to the mating face;

a plurality of contacts extending into the interior cavity of the housing for electrically contacting conductors in the mating connector inserted into the interior cavity of the housing; and

an internal shield extending into the interior cavity, the internal shield including

a base member located adjacent the face; and

a least one separator extending from the base member and into the interior cavity.

36. The electrical connector as recited in claim 35, wherein the face is an upper face.

37. An electrical connector comprising:

a housing having an interior cavity for receiving a mating connector and a plurality of openings in communication with the interior cavity;

a plurality of contacts, each extending into the interior cavity of the housing from a respective one of the openings, for electrically contacting conductors in the mating connector inserted into the interior cavity of the housing; and

an internal shield comprising a plurality of separators extending into unused contact positions in the interior cavity to separate the contacts into groups.

38. An electrical connector system, comprising:

a plug connector, including:

a housing having a plurality of openings therein; and

a plurality of contacts disposed in at least some of said openings; and a receptacle connector, including:

a housing having a cavity for receiving said plug;

a plurality of terminals, each extending into said cavity for engaging a corresponding one of said plurality of plug contacts; and

a shield extending into at least one unused contact position within said cavity and entering at least one of said plurality of openings during mating.

39. In a receptacle connector having a cavity and conductive elements extending into the cavity to engage a mating connector, wherein the improvement comprises at least one of the conductive elements being an internal shield located between adjacent conductive elements to separate the conductive elements into groups.

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